

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

Amendments to the Claims

1. (Currently amended) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H₂O concentrations and a region subject to relatively low H₂O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component, and

said mesoporous layer occupies a substantially greater portion of one of said high H₂O region and said low H₂O region relative to the other of said high H₂O region and said low H₂O region,

wherein said hydrophilic carbonaceous component comprises a moderate surface area carbon characterized by mean particle size of between about 15 nm and about 70

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

nm in said high H₂O regions.

2. (Original) A device as claimed in claim 1 wherein said mesoporous layer is substantially confined to one of said high H₂O region and said low H₂O region.
3. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer is configured to enhance H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.
4. (Original) A device as claimed in claim 1 wherein said mesoporous layer occupies a substantially greater portion of said high H₂O region.
5. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer occupies a substantially greater portion of said high H₂O region and is configured to enhance H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.
6. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer is configured to diminish H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.
7. (Original) A device as claimed in claim 6 wherein said mesoporous layer occupies a substantially greater portion of said low H₂O region.
8. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer occupies a substantially greater portion of said low H₂O region and is configured to diminish H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer.
9. (Original) A device as claimed in claim 1 wherein:
said electrochemical conversion assembly defines an anode side of said device and a

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

cathode side of said device;

said first reactant input and said first product output are in communication with said anode side of said device;

said second reactant input and said second product output are in communication with said cathode side of said device.

10. (Currently amended) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to enhance H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively high H₂O concentrations is proximate said second product output in communication with said cathode side of said device; and

said mesoporous layer occupies a substantially greater portion of said high H₂O region proximate said second product output.

11. (Currently amended) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to enhance H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively high H₂O concentrations is proximate said first reactant input in communication with said anode side of said device; and

said mesoporous layer occupies a substantially greater portion of said high H₂O region proximate said first reactant input.

12. (Currently amended) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to diminish H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively low H₂O concentrations is proximate said second reactant input in communication with said cathode side of said device; and

said mesoporous layer occupies a substantially greater portion of said low H₂O region

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

proximate said second reactant input.

13. (Currently amended) A device as claimed in claim 9 wherein:

said mesoporous layer is configured to diminish H₂O transfer properties of at least one of said first and second diffusion media substrates along said portion of said major face occupied by said mesoporous layer;

said region subject to relatively low H₂O concentrations is proximate said first product output in communication with said anode side of said device; and

said mesoporous layer occupies a substantially greater portion of said low H₂O region proximate said first product output.

14. (Original) A device as claimed in claim 1 wherein a plurality of said mesoporous layers are carried along respective portions of a major face of one of said first and second diffusion media substrates.

15. (Currently amended) A device as claimed in claim 14 wherein:

a mesoporous layer configured to enhance H₂O transfer properties of at least one of said first and second diffusion media substrates occupies a substantially greater portion of said high H₂O region; and

a mesoporous layer configured to diminish H₂O transfer properties of said diffusion media substrate occupies a substantially greater portion of said low H₂O region.

16. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer is carried along a reduced thickness portion of at least one of said first and second diffusion media substrates.

17. (Original) A device as claimed in claim 16 wherein a difference in thickness of said substrate introduced said reduced thickness portion of said substrate is sufficient to accommodate for an increase in diffusion media thickness introduced by said mesoporous layer.

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

18. (Currently amended) A device as claimed in claim 1 wherein said diffusion media substrates comprises a carbonaceous fibrous matrix.

19. (Original) A device as claimed in claim 1 wherein said hydrophobic component of said mesoporous layer comprises a fluorinated polymer.

20. (Original) A device as claimed in claim 1 wherein said hydrophilic carbonaceous component of said mesoporous layer is selected from carbon black, graphite, carbon fibers, carbon fullerenes, carbon nanotubes, and combinations thereof.

21. (Currently amended) A device as claimed in claim 1 wherein said ~~hydrophilic carbonaceous component comprises a moderate surface area carbon is~~ characterized by a surface area of between about 60 m²/g and about 300 m²/g ~~and a mean particle size of between about 15 nm and about 70 nm in said high H₂O regions.~~

22. (Original) A device as claimed in claim 1 wherein said hydrophilic carbonaceous component comprises a high surface area carbon characterized by a surface area of above about 750 m²/g and a mean particle size of less than about 20 nm in said low H₂O regions.

23. (Original) A device as claimed in claim 1 wherein said mesoporous layer comprises about 80 wt% of said carbonaceous component in said high H₂O region.

24. (Original) A device as claimed in claim 1 wherein said mesoporous layer comprises between about 75 wt% and about 85 wt% of said carbonaceous component in said high H₂O region.

25. (Original) A device as claimed in claim 1 wherein said mesoporous layer comprises between

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

about 90 wt% and about 95 w% of said carbonaceous component in said low H₂O region.

26. (Original) A device as claimed in claim 1 wherein said mesoporous layer defines a thickness of less than about 20µm in said high H₂O regions.

27. (Original) A device as claimed in claim 1 wherein said mesoporous layer defines a thickness of between about 10µm and about 40µm in said low H₂O regions.

28. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer at least partially infiltrates at least one of said first and second diffusion media substrates.

29. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer infiltrates at least one of said first and second diffusion media substrates to a depth of less than 10µm in said high H₂O regions.

30. (Currently amended) A device as claimed in claim 1 wherein said mesoporous layer infiltrates at least one of said first and second diffusion media substrates to a depth of less than 25µm in said low H₂O regions.

31. (Original) A device as claimed in claim 1 wherein said device comprises a fuel cell.

32. (Original) A device as claimed in claim 31 wherein said device further comprises structure defining a vehicle powered by said fuel cell.

33. (Currently amended) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

multiphase reactants between said first flow field region and said electrochemical conversion assembly;

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H₂O concentrations and a region subject to relatively low H₂O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component,

at least one of said first and second diffusion media substrates comprises a relatively high porosity region and a relatively low porosity region,

said relatively high porosity region of said substrate occupies a substantially greater portion of said high H₂O region and said relatively low porosity region of said substrate occupies a substantially greater portion of said low H₂O region,

wherein said hydrophilic carbonaceous component comprises a moderate surface area carbon characterized by mean particle size of between about 15 nm and about 70 nm in said high H₂O regions.

34. (Original) A device as claimed in claim 33 wherein said relatively high porosity region is characterized by a porosity of up to about 90%.

35. (Original) A device as claimed in claim 33 wherein said relatively low porosity region is

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

characterized by a porosity of between about 70% and about 75%.

36. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a porosity of above about 70% in said high H₂O regions.

37. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a porosity of between about 70% and about 75% in said low H₂O regions.

38. (Original) A device as claimed in claim 33 wherein said substrate defines a thickness of between about 100μm and about 300μm in said high H₂O regions.

39. (Original) A device as claimed in claim 33 wherein said substrate defines a thickness of between about 190μm and about 300μm in said low H₂O regions.

40. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a mean pore size of above about 20μm in said high H₂O regions.

41. (Original) A device as claimed in claim 33 wherein said substrate is characterized by a mean pore size of less than about 25μm in said low H₂O regions.

42. (Original) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

a second reactant input and a second product output in communication with said second flow field region; and

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H_2O concentrations and a region subject to relatively low H_2O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component,

said mesoporous layer occupies substantial portions of said high H_2O region and said low H_2O region,

said mesoporous layer comprises a region of increased porosity relative to a remaining portion of said mesoporous layer,

said region of increased porosity of said mesoporous layer occupies a substantially greater portion of said high H_2O region relative to said low H_2O region, and

said remaining portion of said mesoporous layer occupies a substantially greater portion of said low H_2O region relative to said high H_2O region.

43. (Original) A device as claimed in claim 42 wherein said region of increased porosity of said mesoporous layer is defined by a plurality of megapores characterized by a pore size of between about $100\mu m$ and about $500\mu m$.

44. (New) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H₂O concentrations and a region subject to relatively low H₂O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component, said mesoporous layer at least partially infiltrating at least one of said first and second diffusion media substrates, and

said mesoporous layer occupies a substantially greater portion of one of said high H₂O region and said low H₂O region relative to the other of said high H₂O region and said low H₂O region.

45. (New) A device configured to convert a hydrogenous fuel source to electrical energy, said device comprising:

an electrochemical conversion assembly configured to partition said device into first and second flow field regions;

a first reactant input and a first product output in communication with said first flow field region;

a first diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said first flow field region and said electrochemical conversion assembly;

Serial No.: 10/628,318

Docket No.: GMC 0047 PA/40320.52

a second reactant input and a second product output in communication with said second flow field region; and

a second diffusion media comprising a porous diffusion media substrate configured to pass multiphase reactants between said second flow field region and said electrochemical conversion assembly, wherein

said device is configured such that at least one of said first and second diffusion media comprise a region subject to relatively high H₂O concentrations and a region subject to relatively low H₂O concentrations,

a mesoporous layer is carried along at least a portion of a major face of one of said first and second diffusion media substrates and comprises a hydrophilic carbonaceous component and a hydrophobic component, said mesoporous layer at least partially infiltrating at least one of said first and second diffusion media substrates, and

at least one of said first and second diffusion media substrates comprises a relatively high porosity region and a relatively low porosity region,

said relatively high porosity region of said substrate occupies a substantially greater portion of said high H₂O region and said relatively low porosity region of said substrate occupies a substantially greater portion of said low H₂O region